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RAPID FEED PAINTBALL LOADER WITH PIVOTABLE DEFLECTOR

RELATED APPLICATIONS

This application is a continuation-in-part of a co-pending U.S. Patent Application (Serial No. 09/465,440, Attorney Docket No. 1280-0001) entitled "Rapid Feed Paintball Loader", filed December 16, 1999 in the names of James T. Christopher and Albert G. Schilling.

BACKGROUND OF THE INVENTION

Technical Field of the Invention

This invention relates to paintball loaders, and more particularly, to a paintball loader which forcibly and rapidly feeds paintballs into a paintball gun.

Description of Related Art

Operators of paintball guns are constantly seeking increased performance from paintball guns. Operators use these paintball guns in a war game having two teams of players trying to capture one another's

flag. The war game is played on a large field with opposing home bases at each end. Each team's flag is located at the player's home base. In addition, all of the players have a paintball gun that shoots paintballs. These paintballs are gelatin-covered spherical capsules filled with paint. During play of the game, the players on each team advance towards the opposing team's base in hopes of stealing the opposing team's flag, without being eliminated from the war game. A player is eliminated from the game when the player is hit by a paintball fired from an opposing player's gun. When the paintball hits a player, a "splat" of paint is left on the player.

Typically, an existing paintball loader includes a housing which is placed on an upper portion of a paintball gun. The housing is shaped to hold a large quantity of paintballs. At the bottom of the housing is an outlet tube through which the paintballs drop by the force of gravity. The outlet tube leads to an inlet tube located on the upper portion of the gun.

During the operation of existing paintball loaders, paintballs sequentially drop by gravity through the outlet tube into the inlet tube of the gun. The inlet tube directs each paintball into the firing chamber of the gun, where the paintball is propelled outwardly from the gun by compressed air.

Co-pending U.S. Patent Application No.09/465,440 describes a paintball feed system providing enhanced performance over existing

paintball feed systems by utilizing a drive cone to forcibly feed paintballs into the gun. However, jams may still occur when rapidly feeding paintballs to the gun. Additionally, an operator cannot control the speed at which the paintballs are fed to the gun. A motor which drives the drive cone, has only two speeds at which it operates, zero and full speed. The two speed operation of the motor inefficiently feeds paintballs to the paintball gun. Therefore, to increase the performance of a paintball gun, a paintball loader is needed which reliably and forcibly delivers paintballs to a paintball gun at a rapid, selectable rate, while actively preventing paintball jams.

Thus, it would be a distinct advantage to have an apparatus which feeds the paintballs at a selectable and rapid rate into the paintball gun, while simultaneously actively preventing jams from occurring during the operation of the paintball gun and loader. It is an object of the present invention to provide such an apparatus.

SUMMARY OF THE INVENTION

In one aspect, the present invention is a rapid feed paintball loader for use on a paintball gun. The paintball loader includes a container for holding a plurality of paintballs, a paintball agitating device mounted on a bottom portion of the container, and an exit tube exiting from a side wall near the bottom portion of the container and leading to an inlet tube of the

paintball gun. The paintball loader also includes a tube extension mounted on an interior surface of the container adjacent to the exit tube, a motor that rotates the paintball agitating device, and a deflector for deflecting paintballs downward into the gaps between the fins or upward to pass over the tube extension. The deflector is pivotably attached to the interior surface of the container adjacent to the tube extension and is mounted at a height above the top feed surface of the agitating device and below a bottom portion of the tube extension. In addition, the paintball loader includes a means for actuating the motor upon demand.

In another aspect, the present invention is a rapid feed paintball loader for use on a paintball gun. The paintball loader includes a plurality of fins located at a bottom portion of the container. Each fin has a top surface and with an adjacent fin forms a gap large enough to accommodate a paintball. The paintball loader also includes means for rotating the plurality of fins about an axis running perpendicularly through the bottom portion of the container.

In still another aspect, the present invention is a rapid feed paintball loader which includes a detector for detecting a presence of paintballs at a selected position within the exit tube and a microprocessor which variably controls the speed of the motor. The microprocessor decreases the speed of the motor when receiving a signal from the detector that the presence of paintballs is detected in the exit tube and increases the speed

of the motor when receiving a signal from the detector that paintballs are not present in the exit tube.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawings, in conjunction with the accompanying specification, in which:

FIG. 1 is a side elevational view of a rapid feed paintball loader constructed in accordance with the teachings of the present invention and operatively attached to a representative paintball gun illustrated in phantom;

FIG. 2 is a top view of the lower portion of the rapid feed paintball loader of FIG. 1 showing a drive cone;

FIG. 3 is a side interior cut-away view of the paintball loader of FIG. 2 illustrating the drive cone, the exit tube, the loaded paintball, a motor, and the paintball tube extension;

FIG. 4 is a top view of the drive cone of FIG. 2 showing the plurality of fins; and

FIG. 5 is a top perspective view of the lower portion of the paintball container with the drive cone removed illustrating the paintball tube extension, pivotable deflector, and exit tube.

DETAILED DESCRIPTION OF EMBODIMENTS

A paintball loader for rapidly delivering paintballs at a selectable speed to a paintball gun while actively preventing jams is disclosed.

FIG. 1 is a side elevational view of a rapid feed paintball loader 40 constructed in accordance with the teachings of the present invention and operatively attached to a representative paintball gun 20 illustrated in phantom. The paintball gun 20 includes a main body 22, a compressed gas cylinder 24, a front handgrip 26, a barrel 28, and a rear handgrip 30. The paintball gun also includes an inlet tube 32 leading to a firing chamber (not shown) in the interior of the main body and a trigger 34. The front handgrip projects downwardly from the barrel and provides an area for gripping by an operator of the paintball gun. The compressed gas cylinder is typically secured to a rear portion of the paintball gun. The compressed gas cylinder normally contains CO_2, although any compressible gas may be used.

In operating the paintball gun 20, the trigger 34 is squeezed, thereby actuating the compressed gas cylinder to release bursts of compressed gas. The bursts of gas are used to eject paintballs outwardly through the barrel 28. The paintballs are continually fed by the paintball loader 40 through the inlet tube to the firing chamber. Although FIG. 1 depicts an automatic paintball gun, the paintball gun 20 may also be a semi-automatic gun.

The rapid feed paintball loader 40 includes a paintball container 42 having a container wall 44 forming an interior area 46. The container is divided into an upper portion 48 and a lower portion 50. An exit tube 52 leads from the bottom portion of the container to an outlet opening 54. The exit tube is positioned on top of the inlet tube 32 of the paintball gun 20.

FIG. 2 is a top view of the lower portion 50 of the rapid feed paintball loader of FIG. 1 showing a drive cone 56. Mounted along a vertical center axis 58, located in the approximate center of the interior area, is the drive cone having a conically-shaped interior surface area 60 with a plurality of fins 62 projecting upwardly from the top surface of the drive cone and spiraling outwardly from an outer circumference of the interior area. The drive cone is rotatably attached to a bottom portion of the paintball container, allowing rotation about the center axis. The exit tube 52 projects outwardly from a rim 64 of the lower portion 50 of the container wall 44 at an approximately 45 degree angle from the Y-axis. In addition, an upper part of the exit tube extends towards the interior area to form a paintball tube extension 72. A pivotable deflector 66 extends inwardly towards the vertical center axis from the rim 64. A paintball 68 is illustrated between two fins.

FIG. 3 is a side interior cut-away view of the paintball loader illustrating the drive cone 56, the exit tube 52, the loaded paintball 68, a

drive motor 70, and the paintball tube extension 72. In the preferred embodiment of the present invention, the container wall 44 is curved and extends upwards to form the upper portion 48 (not shown in FIG. 3). The interior area 46 formed by the container wall stores a plurality of paintballs prior to being used by the paintball gun 20. Although a circular shape is illustrated in the top view of FIG.2, the container may be any size and shape which permits the paintballs to drop towards the drive cone 50.

The top feed surface of the drive cone, which is the feed surface between the fins 62 where the paintball 68 rests, is sloped downwardly at an angle of Φ (approximately 45 degrees in the preferred embodiment). The surface may slope at any angle which matches the slope of the exit tube and allows paintballs to feed into the exit tube 52. The exit tube is a circular tube with an inside diameter slightly larger than a conventional paintball. The exit tube leads from an entry opening 74 to the outlet opening 54 which engages with the inlet tube 32 of the paintball gun. The exit tube includes a sloped exit portion 76 and a vertical outlet portion 78. In the preferred embodiment of the present invention, the sloped exit portion of the exit tube is sloped downwardly at an angle of approximately Φ, which is the same slope as the top feed surface of the drive cone. The pivotable deflector 66 is positioned above the top portion of the fins 62 and below the tube extension 72.

The tube extension 72 is located at the entry opening 74. The tube extension is an extension of the exit tube 52. The tube extension extends towards the center axis 58, while maintaining a clearance above the fins 52. The paintball tube extension is formed as a scoop which has an interior radius of curvature approximately equal to the curvature of a paintball. The top of the scoop is positioned so that it partially covers a paintball that is pushed into position by the fins at the entry opening 74 of the exit tube. In this manner, the sloped surface of the drive cone, the radially curved fins, the angled orientation (approximately 45 degrees) of the exit tube, and the tube extension all equate to forcibly drive the paintball into the exit tube.

The drive cone 56 is rotated around the center axis 58 by the drive motor 70. The motor 70 may be a conventional dc electric motor powered by a power supply 80, such as a 9-volt battery. The power supply is illustrated as being located on the outer surface of the container 42, however, the power source may be located in any position which allows the power source to supply power to the motor. The paintball loader 40 may also includes an electro-mechanical motor-actuator switch 71 located in an interior portion of the exit tube 52.

In the preferred embodiment of the present invention, the paintball loader 40 may also include a microprocessor 82 to enhance the performance of the loader as well as providing useful information to a

paintball gun operator. In alternate embodiments, the microprocessor may provide information for the operator on a display 83. The display 83 may be mounted anywhere on the gun or loader which provides an easily visible display to the operator. As illustrated in FIG. 3, the display is located on an outer surface of the container 42. The display may include a backlit background or any device allowing viewing of the display in the dark.

FIG. 4 is a top view of the drive cone 56 of FIG. 2 showing the plurality of fins 62. As discussed above, the plurality of fins originate at the outer circumference of the conically-shaped interior area 60 and spiral outwardly towards the rim 64 of the container wall 44 (not shown in FIG. 4). Each fin forms a gap 84 with an adjacent fin which, at the container wall, is sized slightly larger than a conventional paintball. For example, fins 62a and 62b form the gap to accommodate a conventional paintball. Additionally, each fin curves to the rear as it radiates outwardly from the center axis so that paintballs are pushed outward as well as forward as the drive cone rotates in the forward direction (counter-clockwise when viewed from above).

FIG. 5 is a top perspective view of the lower portion 50 of the paintball container 42 without the drive cone 56 illustrating the paintball tube extension 72, pivotable deflector 66, and exit tube 52. In the preferred embodiment, the tube extension is concavely shaped to

accommodate the paintball 68 by contacting the paintball on its upper half, and guide it into the exit tube. The pivotable deflector is attached to the rim 64 at pivot point 86, allowing the deflector to rotatably move as indicated in FIG. 5.

Referring to FIGs. 1-5, the operation of the rapid feed paintball loader 40 will now be explained. The rapid feed paintball loader is positioned on the top of the paintball gun 20. The loader 40 is connected to the gun by attaching the exit tube 52, at the outlet opening 54, to the inlet tube 32 with an attaching device such as a clamp (not shown).

When an operator of the paintball gun 20 wishes to shoot paintballs, the trigger 34 is squeezed, which actuates the compressed gas cylinder 24. The compressed gas cylinder releases bursts of compressed gas which are used to eject paintballs through the barrel 28. A plurality of paintballs are stored in the paintball container 42 and pass down the exit tube for use by the paintball gun when demanded by the operator.

The plurality of paintballs located in the container 42 rest on top of the drive cone 56. The bottom-most paintballs drop into the plurality of gaps 84. The drive cone is rotated by the drive motor 70, forcing the paintballs outward and downward from the center axis 58 and forward toward the tube extension 72. The pivotable deflector 66 helps prevent jams by causing paintballs to either fall into one of the gaps between the fins or to rise above the tube extension. The paintball 68 is forced into the

entry opening 74 of the exit tube 52 by the tube extension. In addition, since the drive cone is downwardly sloped toward the exit tube, the paintball falls downwardly, with the assistance of gravity, and outwardly towards the rim 64.

In the preferred embodiment of the present invention, the tube extension grasps the paintball at an upper portion of the paintball. In addition, in the preferred embodiment, the exit tube extends outwardly from the container 42 at an angle θ of approximately 45 degrees from the Y axis. This 45 degree position provides the optimum orientation to feed paintballs into the exit tube. After the paintball enters the entry opening, the next paintball located in an adjacent gap 84 is sequentially grasped by the tube extension and driven into the entry opening behind the first paintball. Additional paintballs located in the container 42, are drawn downwardly and outwardly by gravity and fill the vacated gaps. Positioning the fins on the outer circumference of the interior dome-shaped area prevents paintballs from being lodged in the upper portions of the gaps.

Once the paintball 68 enters the entry opening 74, it passes through the sloped exit portion 76 to the vertical outlet portion 78 of the exit tube. The sloped exit portion of the exit tube is sloped at approximately the same angle as the top feed surface of the drive cone 56, allowing the paintball to enter the exit tube more easily. As the paintball passes

through the exit tube, the paintball may actuate an optional electro-mechanical motor actuator switch (not shown). The motor actuator switch may be utilized to detect the paintball passing through the exit tube. When the paintball enters the exit tube, the motor actuator detects the paintball in the exit tube and shuts off the motor. Thus, when the exit tube fills up with paintballs, the motor is automatically turned off. Then as paintballs vacate the exit tube, the motor actuator does not detect a paintball and engages the motor and rotates the drive cone 56. In this way, the exit tube is always kept full of paintballs, ready for use when demanded by the paintball gun.

Although an electro-mechanical switch has been described to detect the presence of paintballs in the exit tube, it should be understood that other devices may also be utilized to detect the paintballs (e.g., infrared senors, contact pads, optical sensors, etc.), without departing from the scope of the present invention. In the preferred embodiment, a reflective infrared (IR) optical sensor 99 may be utilized. The sensor 99 detects the presence of a paintball in the exit tube by emitting a limited range light from an emitter 95. The range of the light is considerably less than the diameter of the exit tube, however of a sufficient length to strike a paintball located in the exit tube. If a paintball is located within the exit tube, the light emitted from the emitter bounces off the paintball and reflects back to the sensor 99. A detector 97 detects the reflected light,

thus detecting the presence of a paintball. However, if a paintball is not located within the exit tube, the light emitted from the emitted does not reflect off any solid object. Due to the limited range of the emitted light, the light does not strike the opposite side of the exit tube.

There are several advantages in utilizing a reflective light sensor such as sensor 99, as compared to existing sensors. First, the sensor is located in one single integrated device. Other existing devices utilize two sensors located in different places. In addition, the sensor 99 does not require as much power as existing sensor systems, since a limited range light beam is utilized. Existing sensors require transmitting a beam across the entire diameter of the exit tube. In existing sensors, a beam of light is constantly projected across an opening. The existing sensors detect when a paintball is not located in the exit tube, rather than when the paintball is located in the exit tube. Specifically, the beam of light in an existing sensor is detected when the paintball is not in the exit tube. The lack of the beam of light being detected by the existing sensor's detector is the indication that the paintball is present in the exit tube. Although the sensor 99 is the preferred embodiment, other types of sensors may be utilized. For example, a plurality of sensors 75 may be used to detect the paintballs as illustrated in FIG. 3.

To remove jams, the drive cone 56 may be reversed by the motor 70. The curvature of the fins tends to push the paintballs upward and inward toward the top of the cone when the cone is rotated in reverse.

In the preferred embodiment, the microprocessor 82 may also be used to monitor jams within the paintball loader. If paintballs jam within the paintball loader, the drive motor experiences additional resistance in rotating the drive cone. This produces increased torque on the motor and a rise in electrical current. This rise is detected by a motor controller which may be, for example, the microprocessor 82. Upon detection of the rise in electrical current, the microprocessor immediately stops the motor to prevent jamming of a paintball within the exit tube. The microprocessor automatically commands the motor to start up after the jam clears. The microprocessor may be attached to the motor 82 or in any position which allows communication with the motor. When the electro-mechanical switch, or other any other type of sensor, detects the presence of a paintball at the top of the exit tube, the sensor sends a signal to the microprocessor. In turn, the microprocessor sends a signal to disengage the motor. When the motor actuator switch does not detect any paintballs within the exit tube, the sensor signals the microprocessor that the exit tube is not full. The microprocessor can then signal the motor to engage and rotate the drive cone, providing additional paintballs to the paintball gun.

The microprocessor may also perform the function of variably controlling the speed of the motor and the rotational speed of the drive cone. In conjunction with a sensor (electro-mechanical actuator switch, infrared sensor, etc.) within the exit tube 52, the microprocessor varies the speed of the motor to support the demand for paintballs. For example, if the exit tube is not full, more paintballs need to be supplied for entry into the paintball gun. The microprocessor then sends a command to the motor to increase the RPM, thus increasing the supply of paintballs to the gun. If the exit tube is full, as detected by the sensor, the motor is stopped by the microprocessor. As the demand for paintballs increases, the microprocessor commands the incremental increase in power to the motor, resulting in an increase in RPM of the drive cone. In existing devices, there are only two speeds associated with the motor, full speed or zero speed. With the use of the microprocessor, the motor can be variably controlled to supply paintballs according to the demand of the gun operator. The use of the microprocessor to variably control the speed of the motor may be utilized on any paintball gun loader requiring the use of a motor to feed paintballs to the paintball gun.

In the preferred embodiment of the present invention, the microprocessor changes the speed of the motor by varying the duty cycle available to the motor 82, rather than changing the voltage delivered to the motor. The duty cycle available to the motor is varied by pulse width

modulation, which is a technique well known in the art of electronics. For example, the duty cycle is increased to increase the speed of the motor. Likewise, the duty cycle is decreased by the microprocessor to decrease the speed of the motor. The power utilization of the motor is more efficient by utilizing pulse width modulation to vary the speed of the motor. With low power remaining in a battery, which may be sensed by the microprocessor, the duty cycle may be decreased. This decrease in duty cycle available to the motor allows a battery to provide power to the motor for a longer period of time. Additionally, by utilizing pulse width modulation, any dc electrically powered motor may be used. Thus, an expensive variable speed motor is not necessary to operate the paintball loader 40.

The microprocessor 82 may also be used in conjunction with a display such as an LED or LCD display to present relevant data to the operator of the paintball gun 20. The microprocessor may be used to count the amount of shots fired or shots per second fired by the paintball gun by receiving data from the sensor located within the exit tube 52 (e.g., the number of paintballs passing through the exit tube detected by the sensor). Additionally, the microprocessor may be connected to the power supply 80, displaying the power remaining in the power supply. For example, the microprocessor may monitor the remaining life of a battery, if a battery is used as the power supply. The microprocessor can then

present this data to the operator through the display 83, which may be affixed on top of the rapid feed paintball loader, for easy viewing by the operator. As discussed above, the microprocessor may also vary the duty cycle of the electric power in response to the remaining power available from the battery.

A timer (not shown) may also be incorporated into the paintball loader 40. The timer may provide the running time of the game as well as an audio, visual, or vibratory warning to the operator when a predetermined amount of time remains in the game. The timer may be a separate display located on the paintball loader or may be controlled by the microprocessor 82 on the central display 83.

The pivotable deflector 66 provides an active device to prevent the jamming of paintballs within the paintball loader. In existing paintball loaders, a paintball may be lodged between the tube extension or entry opening of the exit tube and one of the fins or "agitators" driving the paintball towards the exit tube, causing the loader to jam and stopping the rotation of the drive cone. To prevent the paintball from lodging between the tube extension (or extension of the exit tube in existing loaders) and a fin (or agitator in existing loaders), the pivotable deflector forces the paintball to either fall into one of the gaps between the fins or to rise upwardly away from the tube extension. In addition, the deflector pivots away from the paintball, thus preventing the paintball from lodging

between the fin and the deflector. The deflector, although depicted with the paintball loader 40 illustrated in FIGs. 1-5, may be utilized on any active feed paintball loader to prevent the inadvertent lodging of paintballs between a fin (or other agitating device) and the entry of the exit tube.

The paintball loader 40 provides many advantages over existing paintball loaders. Existing paintball loaders suffer from the disadvantage of numerous jams within the paintball container because of a paintball unintentionally being lodged between an agitating device and the entry way to the exit tube. The paintball loader prevents the jamming of the paintball between the agitating device and the entry way by providing a pivotable deflector to deflect paintballs from lodging in undesirable locations. Thus, the pivotable deflector actively prevents the jamming of paintballs within the paintball loader.

The paintball loader 40 also provides the advantage of variably controlling the feed rate of the paintballs to the paintball gun. In existing paintball loaders, the motor driving the agitating device has only two speeds, full speed and zero speed. The paintball loader 40 provides a full range of speeds of the motor to change the speed at which the paintballs are delivered to the paintball gun. A sensor or plurality of sensors within the exit tube provide the microprocessor information when the demand increases for paintballs, as indicated by an empty or half full exit tube. The microprocessor and sensor located within the exit tube may be used

in any paintball loader, thus providing variable feed rates to the paintball gun.

The paintball loader 40 also enhances the feed rate of the paintballs to the paintball gun by orientating the exit tube at approximately a 45 degree angle from the Y axis of the paintball loader. This orientation provides the optimum position to feed paintballs into the exit tube, thus increasing the delivery rate to the paintball gun.

It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the apparatus shown and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein without departing from the scope of the invention as defined in the following claims.